

Service Manual No. 5L

General Installation and Operation

INSTRUCTIONS

For Burdick Quartz Light Equipment

Burdick Cabinet Company
Milton, Wisconsin

Second Edition

General Instructions

THE following instructions are general in nature, covering all types of Quartz Lamp equipment. Detail installation instructions will be found on tags attached to the various pieces of Quartz Lamp apparatus. This manual covers *Electrical Connections, Electrical Adjustments, Operation, Electrical Characteristics, Care and Maintenance*, and should be kept at hand by the operator for reference.

Satisfactory service from this equipment can be obtained only by carefully following these instructions. We particularly caution users of Lamps on *Direct Current* to be very careful about correct *Polarity*.

BURDICK CABINET COMPANY,
Milton, Wisconsin.

Revised May 1926

Table No. 1

The following table shows the minimum size (B. & S. gauge) wire which we recommend for the branch circuit from service connection to Quartz Lamp, Deep Therapy Lamp and Combination Outfits. Do not use this table if other apparatus is connected to the same circuit.

The Direct Current Quartz Lamp should be fused for 12 amperes, the Alternating Current Quartz Lamp for 20 amperes, the 1000-watt Deep Therapy Lamp for 10 amperes, and the 1500-watt Deep Therapy Lamp for 15 amperes.

Length of Circuit (2 wires between Apparatus and Service Meter) (feet)	D. C. Quartz Lamp	A. C. Quartz Lamp	Combination of D. C. Quartz Lamp with 1000 Watt D. T.	Combination of A. C. Quartz Lamp with 1000 Watt D. T.	Combination of A. C. Quartz Lamp with 1500 Watt D. T.
		1000 Watt D. T.	1500 Watt D. T.	Combination of D. C. Quartz Lamp with 1500 Watt D. T.	
10	14	14	14	14	14
20	14	14	14	14	14
30	14	14	14	14	12
40	14	14	14	12	10
50	14	14	12	10	10
60	14	14	12	10	10
70	14	12	10	10	8
80	14	12	10	8	8
90	12	12	10	8	8
100	12	10	10	8	8
120	12	10	8	8	6
140	10	10	8	6	6
160	10	8	8	6	4
180	10	8	6	6	4
200	10	8	6	4	4

Electrical Connections

THE large cable coming from the bottom of the control should be connected to the supply circuit. Before making connections, make sure that the voltage, and frequency (if alternating current) of the line corresponds to the rating plate.

We recommend that the wiring be done by a competent electrician according to the local Elec-

trical Code. It is advisable to run a separate circuit from the apparatus to the entrance of the electrical service to the building. Very few, if any, lamp sockets have sufficient capacity to supply this equipment without being overloaded. However, on *Direct Current* outfits, it will be possible to connect to a lamp socket provided there are no other lamps or apparatus on that branch circuit.

For best results, No. 10 or larger wire should be used. In order to keep the voltage drop in the line

down to the minimum, we recommend that you follow table No. 1 (page 4) for size of wire to use, depending upon the distance run.

Care should be taken to connect the Quartz Lamp Outfit on a circuit as free from voltage fluctuation as possible. It is also preferable to connect it to a circuit separate from one supplying X-Ray or High Frequency equipment.

Polarity

In connecting a *Direct Current* Outfit to the line, it is very essential to get the polarity correct. *If the Quartz Tube is started on wrong Polarity it will be ruined.*

A polarized plug, (Hubbell 5567, GE 2240, or equivalent) should be used on the entrance cable of a Direct Current outfit in conjunction with suitable polarized receptacle on the supply wires. If connection is made to a drop cord, use a polarized connector (Hubbell 6278, GE717, or equivalent) on the drop cord in place of the regular Edison screw socket. When connecting to a wall outlet use a polarized receptacle (Hubbell 5566, GE1805, or equivalent) in place of the ordinary Edison screw plug receptacle. Make sure the polarized receptacle is connected to a permanent circuit throughout, and not through some non-polarized wiring connection, where the polarity can be changed.

When wiring entrance cable to plug, it is not necessary to know the polarity of the supply wires. Simply connect the wires to the plug so the voltmeter on Control Cabinet indicates in the right direction.

Never start the Arc in Quartz Tube unless Voltmeter Needle indicates in the right direction. This applies at all times, and the operator should be sure polarity is correct each time before starting the lamp. It is possible for the wires in the building to be changed at any time. The operator assumes his own risk in operating the Quartz Tube on wrong polarity.

The connections in the plugs on the cord connecting lamp casing to Control Cabinet must never be changed. If repair becomes necessary, the polarity in the casing at the burner terminals must be tested before starting the burner. This can be done with a D. C. voltmeter, or by attaching wires to the casing terminals immersing the free ends in a glass of salt water. The polarity is correct if bubbles come from the wire which connects to the mercury end (negative or cathode) of burner.

Assembly of Alternating Current Outfit

Remove the back door in case of the Mobile Unit, or the circular cover on the Floor Stand rectifier, and insert the rectifier bulbs into their sockets. Attach the flexible leads by slipping each clip over the wire protruding from top of bulb. It makes no difference which lead goes to a bulb as they are interchangeable.

The discolored appearance of the glass bulb is due to the condensation of certain purifying agents in the bulb used during the process of manufacture. It is in no way detrimental to the life of the bulb, and is no indication of the length of time it has been operated.

Keep the tag from each bulb and fill it in if the bulb is returned to us at any time.

Electrical Tests and Adjustments

Disconnect the cord running to the Air-Cooled Lamp. Turn the Selective Switch to either *Air-Cooled* or *Water-Cooled*, as the case may be. On the Mobile Units, also turn Main Switch to *On* and Intensity Control to *Low*. The voltmeter should indicate around 110 volts, depending upon the line voltage. On the Alternating Current outfits, if the voltmeter does not indicate, see if the rectifier bulbs light up. If they do not, be sure that the line connections are correct, and that the bulbs are screwed firmly in their sockets. If they light up, but the voltmeter does not indicate, inspect the fuses in the outfit, making sure they are screwed firmly in their sockets. If the meter indicates about 55 volts, it is an indication that one of the fuses or one of the rectifier bulbs is inoperative. Interchange rectifier bulbs and by process of elimination locate the inoperative fuses or rectifier bulb.

When the voltmeter indicates properly, start the lamp; and after it has been burning for about 10 minutes, adjust the Voltage Regulator to obtain 55 volts for the Water-Cooled Lamp or 75 volts for the Air-Cooled Lamp. *Allow several Minutes after adjusting the Voltage Regulator for the Tube to reach equilibrium before accepting the voltmeter reading.*

If the Alternating Current outfit is connected to a line voltage greater than 120, there may not be enough adjustment on the Voltage Regulator to keep the lamp voltage down to the proper value. In this case, slide clamp L (see Figs. 12L and 13L, pages 13 and 14) away from clamp M for one or two inches, and complete the adjustment with the Voltage Regulator. Never move clamp L down any farther than absolutely necessary, always using the maximum amount of resistance on the voltage regulator.

Adjust the voltage on the Air-Cooled Lamp *first* on a combination Air-Cooled and Water-Cooled outfit. In making this adjustment, leave the Air-Cooled Casing *wide open*. Adjust the Voltage Regulator until the voltmeter reads 75 volts. Then start the Water-Cooled Lamp and after it has "built up," note the voltage. It should read within 5 volts either way of 55. If the voltage is not 55, adjust clamp N on the single resistance coil until the Water-Cooled Lamp operates at 55 volts on the same adjustment of the Voltage Regulator that gives 75 volts on the Air-Cooled Lamp. If it reads too high, move clamp N away from clamp M (see wiring diagrams). If the voltage is too low, move clamp N closer to clamp M.

Operation of Self-Contained Mobile Unit

Remove the red indicator glass and pour into the filler spout about one gallon of distilled water.

The Self-Contained Mobile Unit is turned on and off by means of the Main Switch.

When the Selective Switch is set on *Water-Cooled*, the water circulating system will start operating when the Main Switch is turned on. This is indicated by the pilot light back of the red indicator glass, and also by the slight hum made by the fan. When the pilot lamp lights, water should flow in the indicator. If it does not, inspect for lack of water or stoppage in the hose connections. When the outfit is started the first time, it takes about a minute for the water to fill the hose and casing before it runs out in the indicator glass.

When the Selective Switch is thrown to *Air-Cooled*, the water circulating system is automatically disconnected, and the proper running resistance is connected in for the Air-Cooled Lamp.

The Mobile Units are equipped with an Intensity Control Switch, marked *High* and *Low*. The normal operation is on *Low*, which will give about 55 volts on the Water-Cooled Lamp and 75 on the Air-Cooled Lamp. When this switch is thrown to *High*, the voltage on either lamp will be approximately 90 volts. *This switch should be used only when the technique specifically calls for a high voltage.*

Caution: Do not start the lamp with Intensity Control Switch on high or turn from low to high before lamp voltage has reached 50 volts.

Starting Arc in Air-Cooled Lamp

Turn Selective Switch to *Air-Cooled*. When the Air-Cooled Lamp is not equipped with the Automatic Heat Starting Device, the arc is started by rotating knob K (see Fig. 3, page 7) on the left side of the Rotary Casing which operates the tilting mechanism. On the Two Section Casing, there is no tilting device, and the arc is made by gently swinging the casing. Start either type with a gentle motion, and *avoid sudden movements*. Do not allow the mercury to flow out of the bowl into the tube, as this will cause the arc to strike at the negative end, and destroy the cathode seal.

When equipped with automatic starting device, the lamp will start by itself as soon as the current is turned on. This starting device consists of a pre-heater and a relay cut-out. Besides providing automatic starting, it also decreases the time for the arc to "build up," due to the Vapor Generated by the Pre-Heater.

A Nichrome heating coil is wound around the cathode bowl of the tube (see Fig. 9). To start the Arc, set the Selective Switch on "*Air-Cooled*"; the coil should immediately get red hot. The heat from the coil vaporizes the mercury, and the pressure of the vapor in the cathode bowl forces the mercury up into the straight portion of the tube.

When the mercury touches the anode target, the Arc is formed, and current flows through the relay cut-out, opening the circuit to the heating coil. The arc will start about one minute after control switch is closed.

Caution: Always allow enough time (usually about one minute) after arc stops for the mercury to start flowing down into the tube before turning on switch again. If the Arc should be interrupted, immediately turn off switch and wait, as explained above. If these precautions are not observed, the Arc will start to flash off and on, oscillating in this manner indefinitely. If this action is prolonged an arc will form at the cathode or negative end of the tube, destroying the cathode seal.

Starting Arc in Water-Cooled Lamp

Turn Selective Switch to *Water-Cooled*. Tilt the Water-Cooled Casing to a horizontal position and immediately bring it back to the normal vertical position. This motion should be gentle, and the casing should be left in horizontal plane for only an instant. *Never tip casing completely up side down.*

After Arc is started, leave casing in a vertical position except when it is necessary to tilt it in giving a treatment. Tilting the casing for more than a few minutes interferes with proper operation of the Arc.

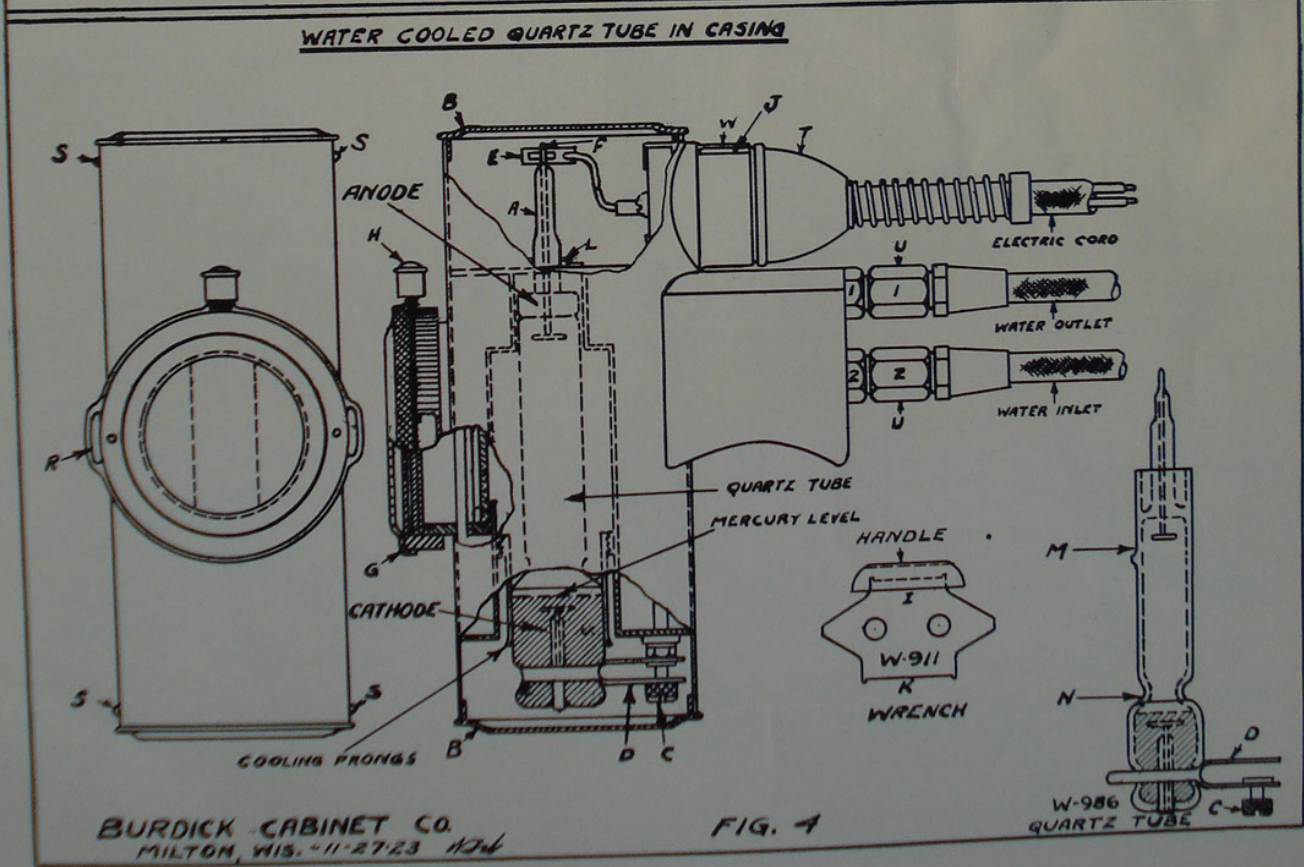
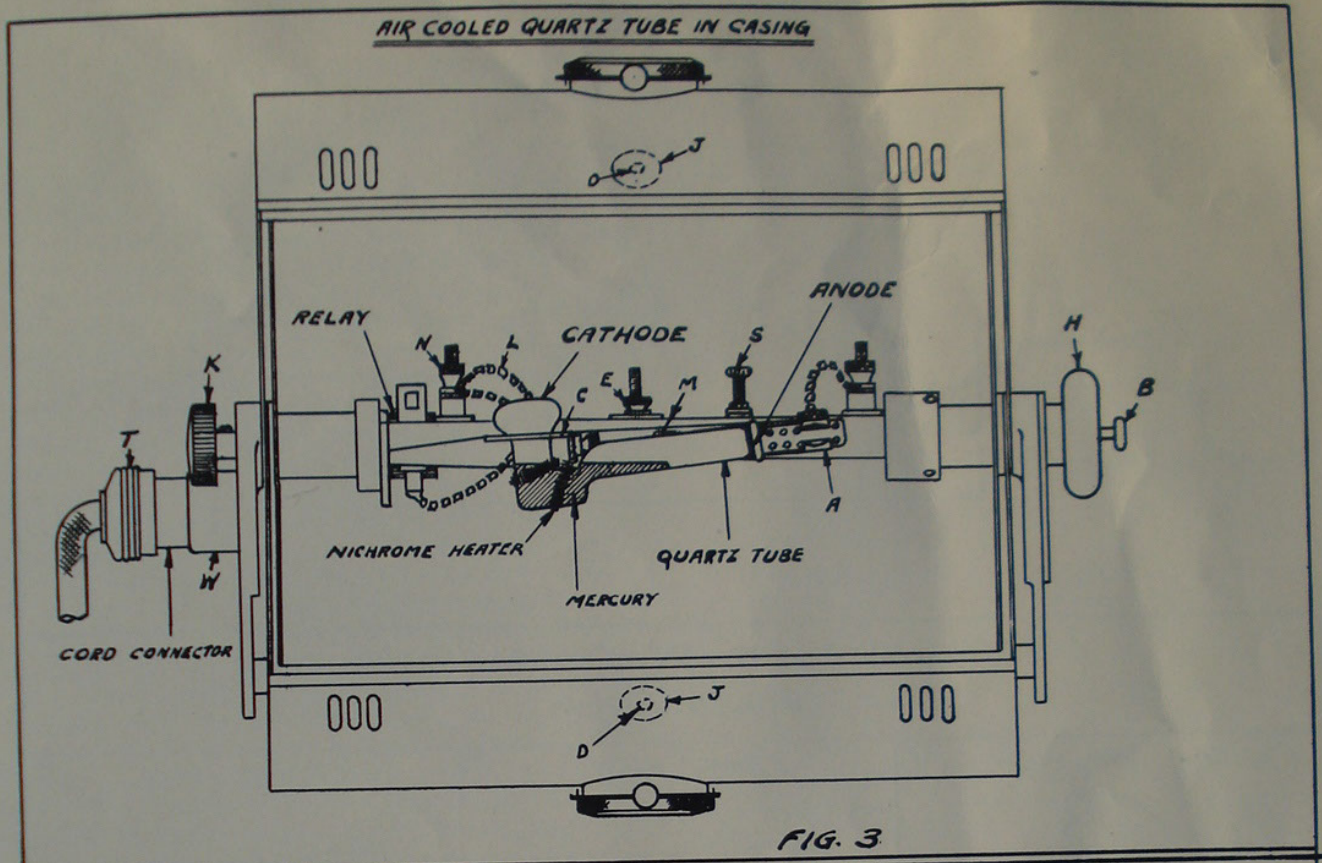
If the Water-Cooled Lamp is not equipped with the new starting device, it will require about ten minutes for the lamp to reach equilibrium, or "build up."

The starting device for the Water-Cooled Quartz Tube consists of a relay in the Control which is connected in such a manner as to cause a more rapid build-up of the Arc. It *does not* provide means for automatic starting, the Arc being started by tilting the casing as explained above. This device can be depended upon to decrease the "build-up" period to at least one-half.

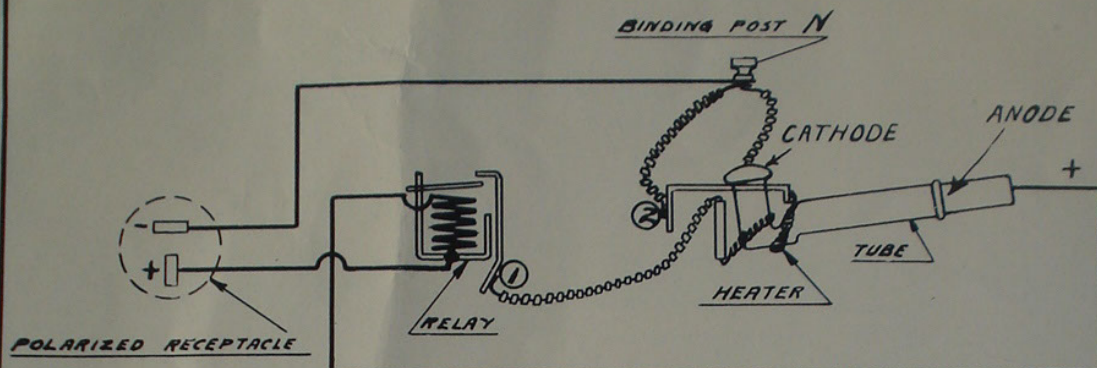
The resistance necessary to operate the Water-Cooled Quartz Tube at 55 volts is so great that it reduces the starting amperage to a value which causes a long "build-up" period. This period is shortened by the relay (see wiring diagrams) which closes when the Arc is started, and shorts out enough resistance to bring the starting current up to about 10 amperes or more. When the current has decreased to about 6 amperes, the relay opens, inserting the running resistance in the circuit. When the relay opens, the voltage has increased to about 55 volts, and the added resistance brings the amperage down to its normal equilibrium value; *so the click of the relay can be taken as a signal that the arc is completely "built up," and ready for use.*

If a relay is not used in the Control, wires "A" and "B" are joined and "C" eliminated. A relay can be added at any time by connecting relay as shown in wiring diagram.

If relay gets out of adjustment, refer to special instructions. The Quartz Tube can be operated without the relay by disconnecting wire "C."



WIRING DIAGRAM OF AIR COOLED CASING



INSTRUCTIONS FOR ATTACHING HEATING COIL IN AIR COOLED LAMP

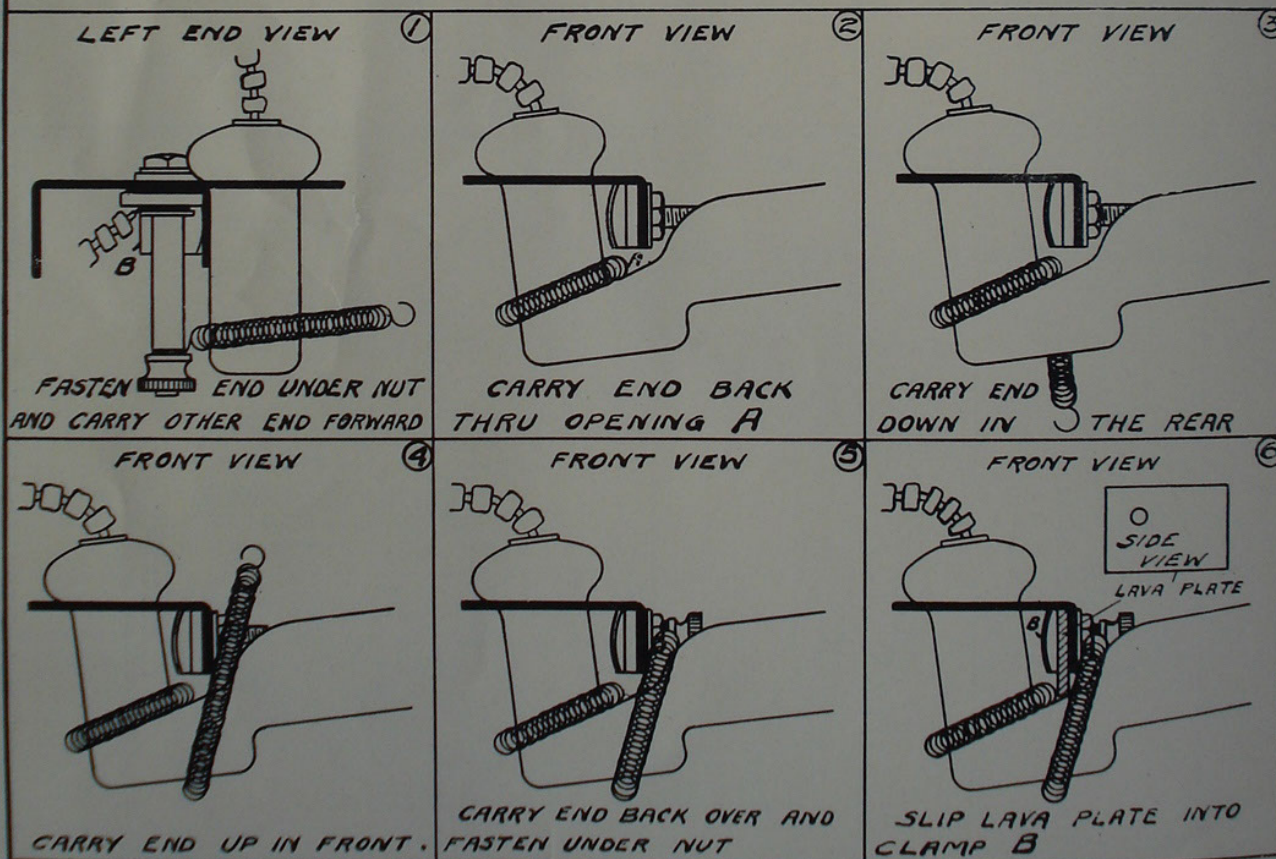


FIG. 9

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Electrical Characteristics of Quartz Lamps *

THE electrical resistance of a mercury vapor Quartz Tube will vary with the temperature and pressure of the Arc. This is why the Quartz Tube has such peculiar electrical characteristics. When the Arc is first started, the vapor pressure, temperature, and the electrical resistance are low; which allows a maximum amount of amperage to flow and the minimum amount of voltage. The starting amperage is controlled entirely by the ballast resistance. As the Arc temperature and pressure increase, the electrical resistance increases, which causes the amperage to decrease. As the amperage decreases, the voltage drop in the ballast resistance decreases which allows the voltage across the Arc to increase. The voltage when the Arc starts is about 20, and will increase to such a value as adjusted by the ballast resistance, or voltage regulator. These changes continue for several minutes until the tube reaches a stage of equilibrium when the electrical energy input balances the output in heat and light radiation. When this equilibrium point is reached, the tube is said to be "built up." The maximum production of Ultra-Violet radiation is secured only when the Arc is completely "built up," and treatment should not be started before this time.

After the Arc is "built up," the amperage is controlled by the amount of heat radiated from the cathode end of the tube, or in other words, by the cooling. The correct amperage is $4\frac{1}{4}$ controlled by the cooling. The correct voltage is 55 for the Water-Cooled Lamp, and 75 for the Air-Cooled Lamp adjusted by the Voltage Regulator after Arc has reached this amperage.

The amperage will increase when the cooling is increased; i.e., when the heat radiated from the tube increases. The voltage at which the Arc runs depends entirely upon the voltage drop in the ballast resistance. The voltage drop in the resistance depends upon the amperage flowing in it, and also the amount of ohms resistance which is adjustable.

The amperage for a given cooling effect will vary for different tubes. This is controlled in the Water-Cooled casing by means of cooling prongs which touch the cathode end of the tube. When more of these prongs are placed in contact with the Tube, the cooling effect and the amperage will be greater. These prongs are adjusted at the factory when a casing is shipped with the quartz tube so that the amperage will be about $4\frac{1}{4}$, and these prongs *should not be changed unless an ammeter is placed in the circuit and it is known that an adjustment is necessary.*

When Water-Cooled Tube is replaced and the casing and tube are not received as a unit from the

factory, it is necessary to use an ammeter and adjust the prongs to obtain $4\frac{1}{4}$ amperes. If an ammeter is not available, adjust cooling prongs to give the same lamp voltage as obtained previously. In making this adjustment remember that the voltage increases when the amperage decreases, and vice versa.

To decrease amperage, pull the cooling prongs away from the Tube. If care is taken, this can be done with a screw driver while tube is in the casing. Pull out one prong at a time, and wait several minutes for the tube to reach equilibrium before accepting the ammeter reading.

To increase amperage, push the prongs in to make more contact on the tube. Remove the Quartz Tube before doing this.

The amperage of the Air-Cooled Lamp will vary according to the ventilation in the casing. When the casing is open, the amperage will be higher, and the voltage lower than when closed. No cooling adjustment is necessary with an Air-Cooled Lamp.

Important

1. Always give the Quartz Tube plenty of time (5 to 10 minutes) to assume a state of equilibrium after any adjustment is made. Failure to do this makes adjustments worthless.
2. The amperage is affected *only* by condition of cooling. Amperage is changed *only momentarily* by changing resistance, and always assumes the original value when burner has reached equilibrium.
3. The voltage is affected *both* by amperage characteristic and resistance adjustment so it is absolutely necessary to make amperage adjustment *first*.
4. Tilting Water-Cooled Casing increases the amperage so casing must be vertical when making amperage and voltage adjustments.
5. Make voltage adjustments on Air-Cooled Lamp with casing open.

To Revolve Rotary Casing

Press on button "B" (see Fig. 3, page 7) and rotate casing by means of handle "H" or by holding on to one of the shutter knobs "J." When button "B" is released, casing is automatically locked.

To operate shutters, press in on button "D" and at the same time raise or lower the shutter to position wanted. The shutter is locked as soon as button is released.

To Attach Auxiliary Reflector

Slide arm under nut "E" (see Fig. 3, page 7) and tighten same when Reflector is in place. Slide Reflector to position wanted with porcelain knob. The friction should hold the Reflector in place, and the knob should not be tightened except when necessary to obtain more friction.

* See Engineering Bulletin QL-105

Operation of Two-Section Casing

Use round handle at right side of Casing to turn inner part to position wanted, and lock by turning straight lever in a clockwise direction.

To Attach Applicator Holders

The Air-Cooled and Water Cooled Casings have the same type of device to hold the Applicator (see Fig. 4, page 7). Press in on knob "H" with finger, and place applicator holder over frame so that the two small lugs fit into slots "R," then release pressure.

Instructions for Removing Electrical Cord

To remove Electrical Cord, pull separable plug "T" (see Fig. 4, page 7) out of socket "W." When replacing cord in Water-Cooled Casing, notice slot "J" for keeping polarity correct.

Instructions for Removing Hose

To remove Water Hose, unscrew nuts "U" (see Fig. 4, page 7) with wrench provided. When replacing Water Hose, make sure nuts are tight enough to prevent leakage and that the number stamped on jam nut "U" corresponds to number on Casing. Remember that the water must always enter the casing through the lower connection.

Care of Quartz Tube

Wash off Air-Cooled Tube with carbon tetrachloride, or grain alcohol, each time before using. This is very important, as finger prints and dust on the Quartz Tube will become etched into the quartz when the lamp is in operation. This impairs the Actinic Ray production and is also detrimental to the quartz.

If the Water-Cooled Quartz Tube is ever removed from the casing, be sure to clean it thoroughly before replacing.

When the Quartz Tube wears out, indicated by loss of vacuum and discoloration, pack it in the same

manner in the crate it was received in, and return to the Burdick Cabinet Company for inspection and adjustment.

Care of Rectifier Valves

Occasionally a Rectifier Valve fails, and it is advisable to keep an extra one always in reserve. When this happens, fill in the tag that came with the valve and return both to the Burdick Cabinet Company. Rectifier Valves which fail prematurely are replaced free of charge if the defective valve is returned with the tag properly filled in.

Care of Water-Cooled Casing

Where a Water-Cooled Casing is connected to the city water supply, the impurities in the water leave a deposit on the quartz windows. This should be cleaned off occasionally to prevent a decrease of Ultra-Violet efficiency.

Remove the outer window (use wrench W911, Fig. 4) and clean with a rag moistened in carbon tetrachloride. If this does not remove the deposit, use a little diluted hydrochloric acid. Clean off all trace of acid before replacing window.

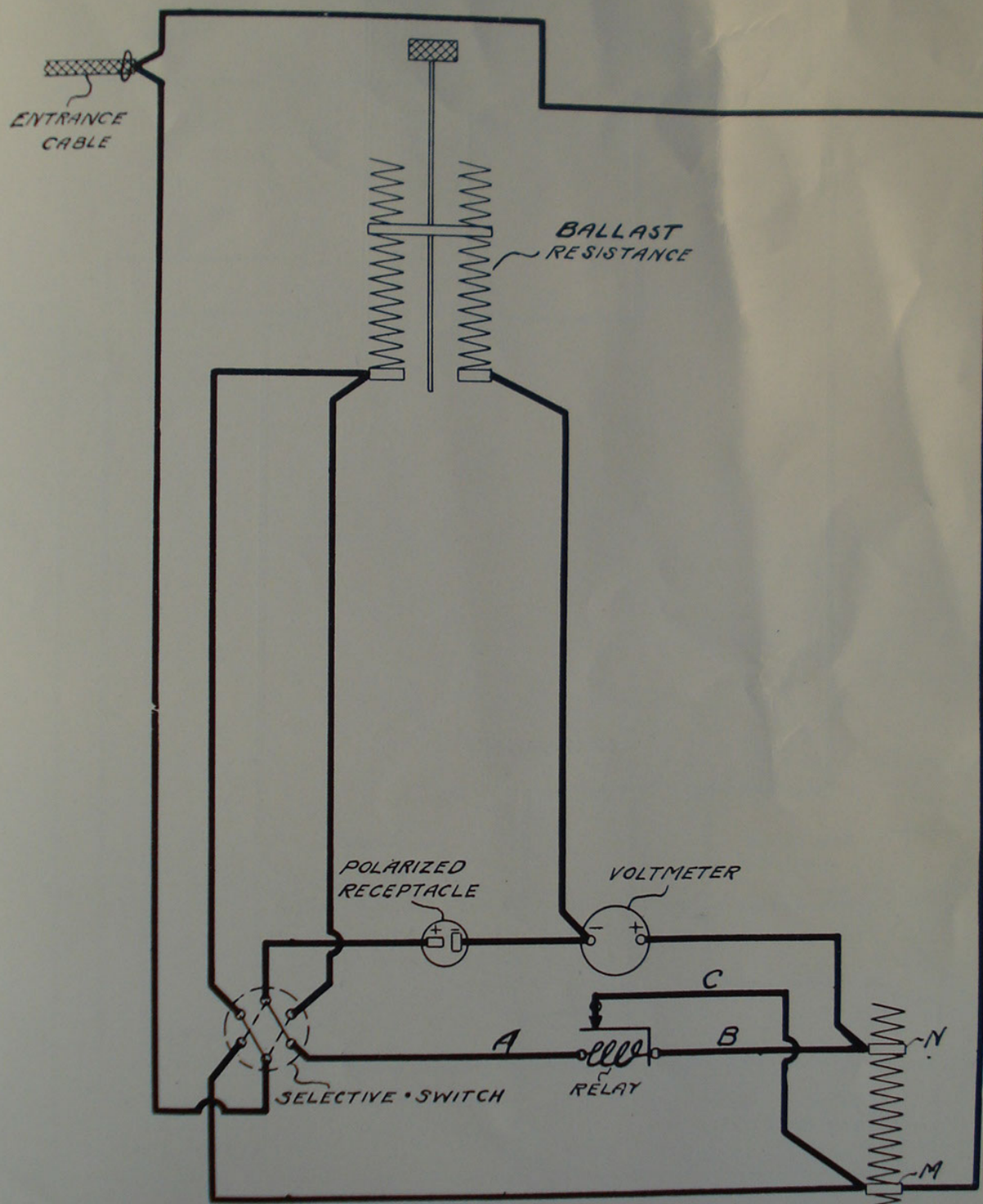
Care of Pump and Motor

Examine the Pump Unit in the Mobile and Self-Contained Units at least four times a year. Fill the two oil cups on motor and the two on fan shaft with light motor oil. Inspect packing nut on pump for water leakage. Tighten packing nut just enough to stop leak.

Cleaning of Enameled Parts

To clean enameled surfaces, use powdered Bon Ami, or Ivory Soap, polish with liquid paraffin, and rub off with a dry cloth. Do not use Sapolio, Gold Dust, or other similar cleaners which will scratch, wear off, or discolor the enamel. Nickel parts should be polished occasionally with a good nickel polish.

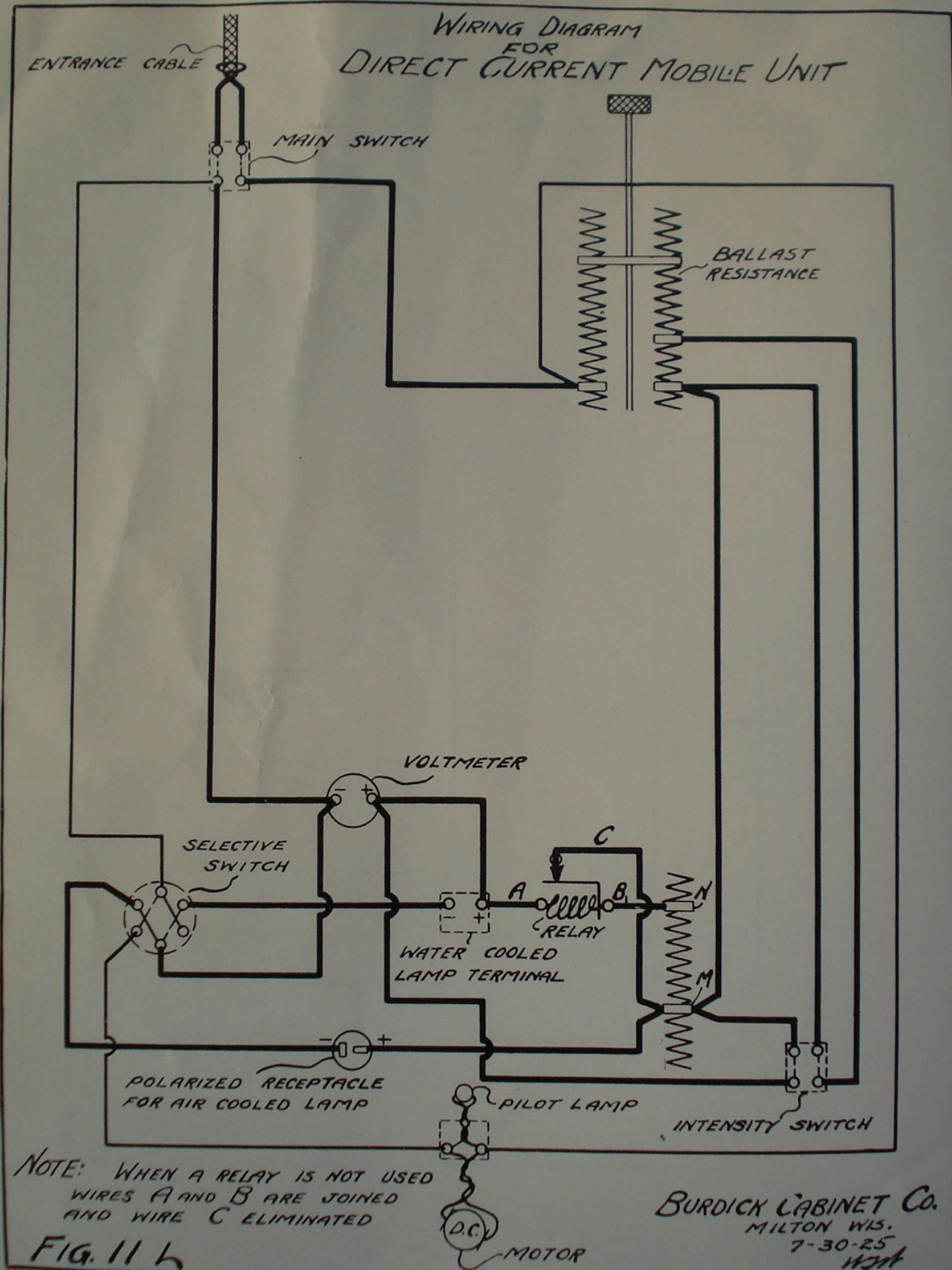
WIRING DIAGRAM FOR DIRECT CURRENT RHEOSTAT CONTROL



NOTE:~ WHEN A RELAY IS NOT USED
WIRES A AND B ARE JOINED
AND WIRE C ELIMINATED.

FIG. 10L

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HJH



WIRING DIAGRAM FOR TWO BULB RECTIFIER

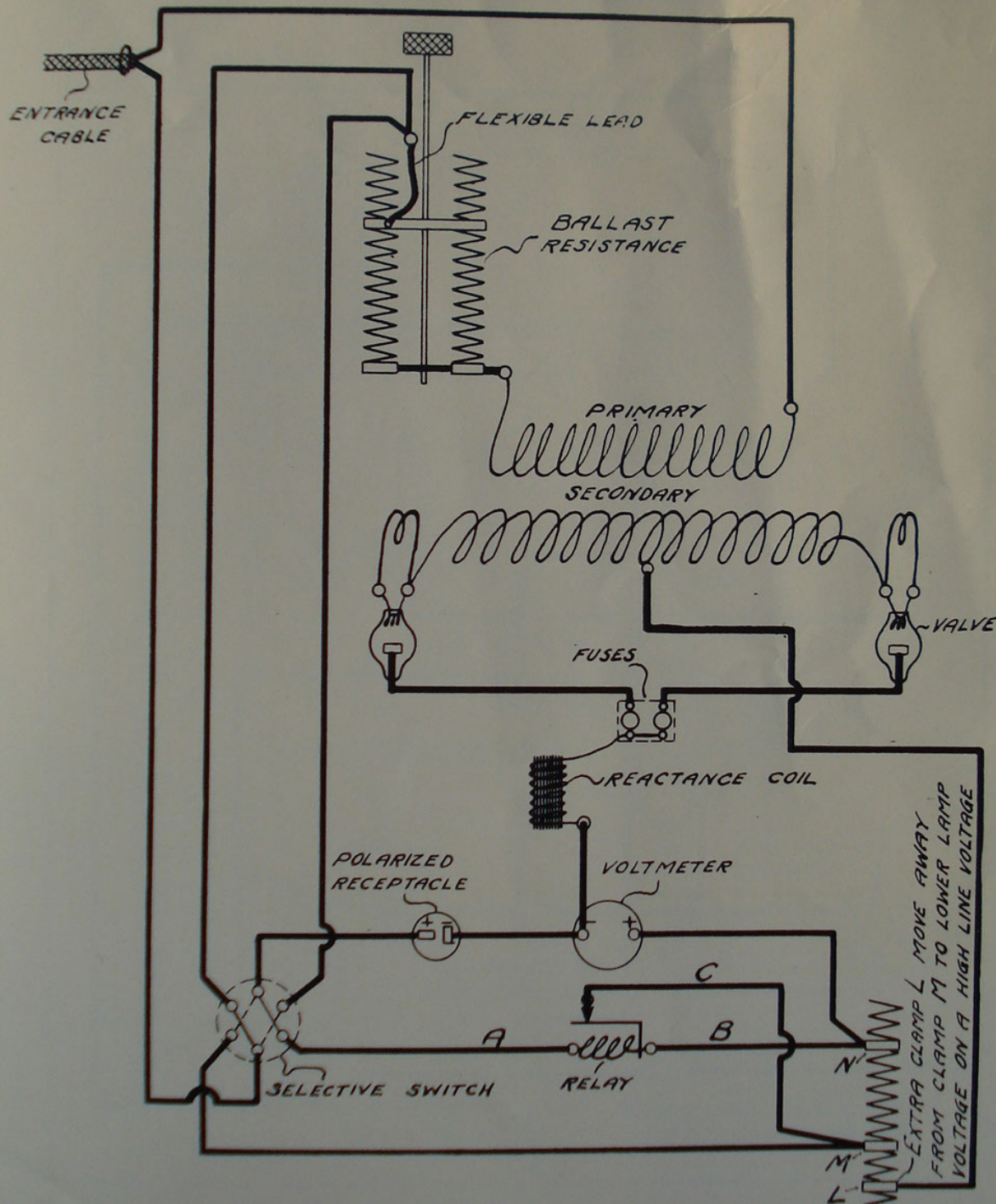
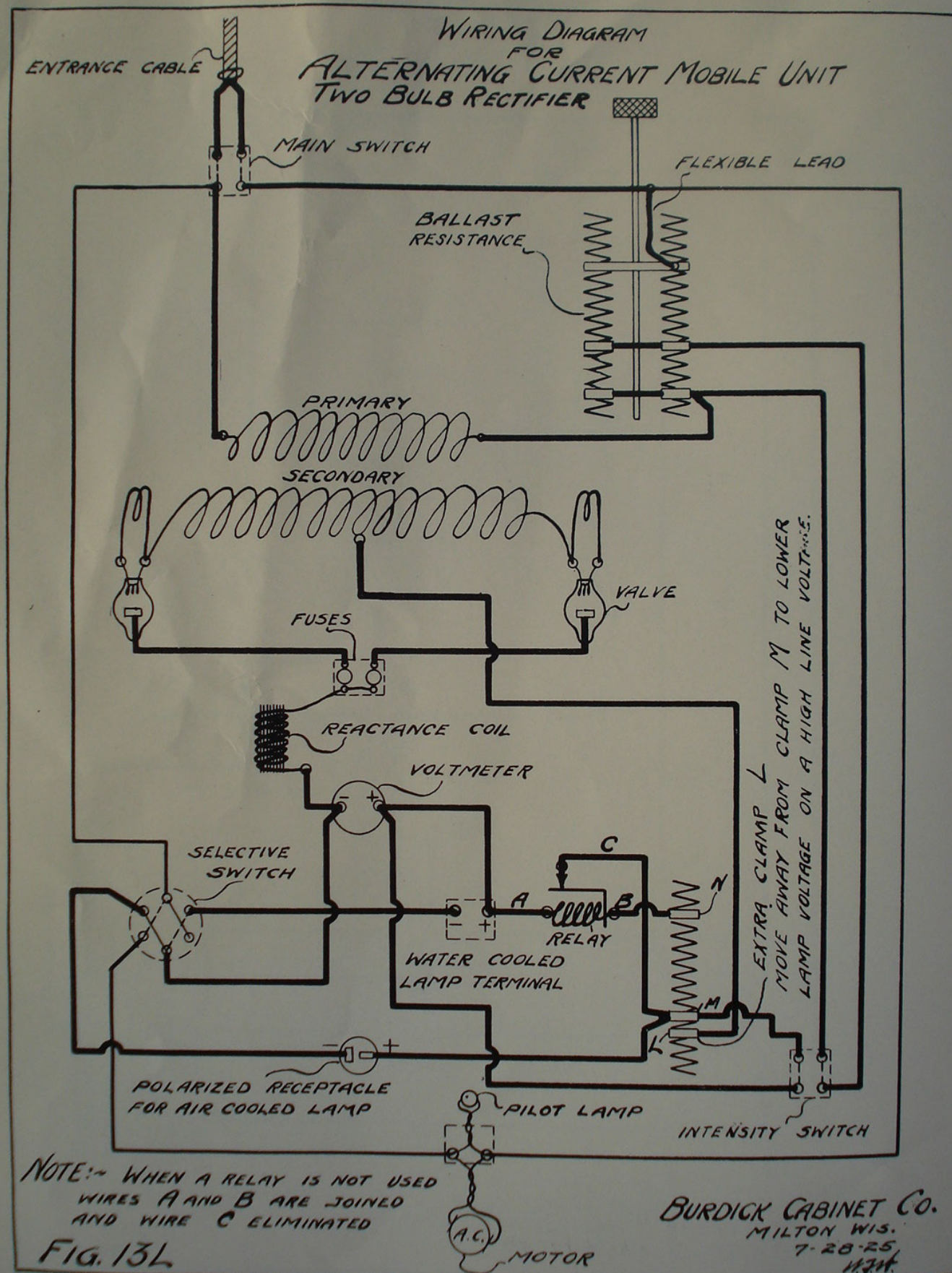
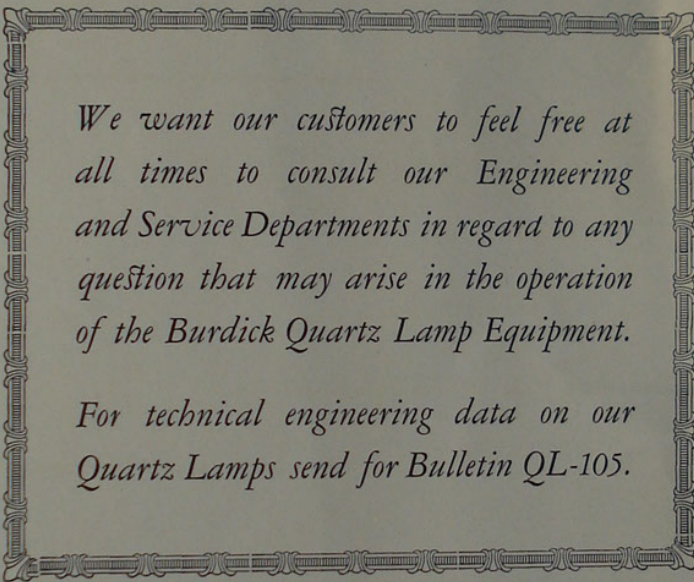


Fig. 12L

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We want our customers to feel free at all times to consult our Engineering and Service Departments in regard to any question that may arise in the operation of the Burdick Quartz Lamp Equipment.

For technical engineering data on our Quartz Lamps send for Bulletin QL-105.